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Chapter 2

The CHORS Immersion Factor Method

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Abstract

The CHORS method for experimentally determining the immersion factor for irradiance sensors is based on the method developed at the Visibility Laboratory for this measurement. It uses tap water and has the following major features: a) it uses a large covered tank with a sensor support system, which places the radiometer well above the turbulence associated with filling and emptying the tank (the volume of water below the sensor is greater than the amount above the sensor) or any perturbations from the bottom of the tank, so the interior of the tank (when covered) is especially *black*; b) it uses a 400 W lamp with a very small filament, so the light source very nearly approximates a point source; and c) it uses an adjustable final baffle to ensure the cone of light illuminating the in-water sensor is as small as possible.

2.1 INTRODUCTION

The CHORS laboratory procedure for characterizing immersion coefficients for an irradiance sensor was first described in Petzold and Austin (1988). The apparatus used was designed to accept a large variety of sensor types, both large and small, from different manufacturers. Although measurement accuracy was an important objective of the method, another priority was to be able to execute the measurement process in a time-efficient manner.

2.2 LABORATORY SETUP

The characterization of immersion factors at CHORS took place in a *high-bay* facility adjacent to the room used for radiometric calibrations. The walls and ceiling of the facility were painted flat black to remove any significant sources of reflected or secondary illumination.

A schematic of the CHORS measurement system for measuring $I_f(\lambda)$ for cosine collectors, is shown in Fig. 2. It consisted primarily of a large fiberglass tank in which the radiometer to be characterized could be immersed, a screened 400 W tungsten-halogen lamp with a power supply (PS) and multiple baffles, a reference radiometer to monitor the lamp, and a ducted fan to keep the lamp and reference cooled. The in-water sensor was placed in a support frame on top of a grated platform. The platform was covered with a fine black mesh and provided two functions:

1. It significantly reduced any water turbulance during the filling (and, to a lesser extent, the draining) of the tank; and
2. It provided a horizontal surface which allowed the sensor support frame to be accurately leveled and positioned within the baffled light field.

To reduce light reflections within the tank, the interior was painted with an exterior flat black paint, and the metal surfaces of the grated platform plus the sensor support frame were covered with black tape or black paint. The inside of the tank lid was painted black, and a large opening in the lid was fitted with a black curtain which could be drawn back to permit easy access to the inside of the tank.

The sensor support frame was composed primarily of a tube with an inner diameter just a little larger than the outer diameter of the in-water radiometer. A D-shaped collar was fitted to each in-water sensor which leveled the radiometer against the top of the tube. The flat side of the D-shaped collar (Fig. 1) was used as a coarse alignment reference to ensure the radiometer was positioned in a reproducible fashion within the light field.